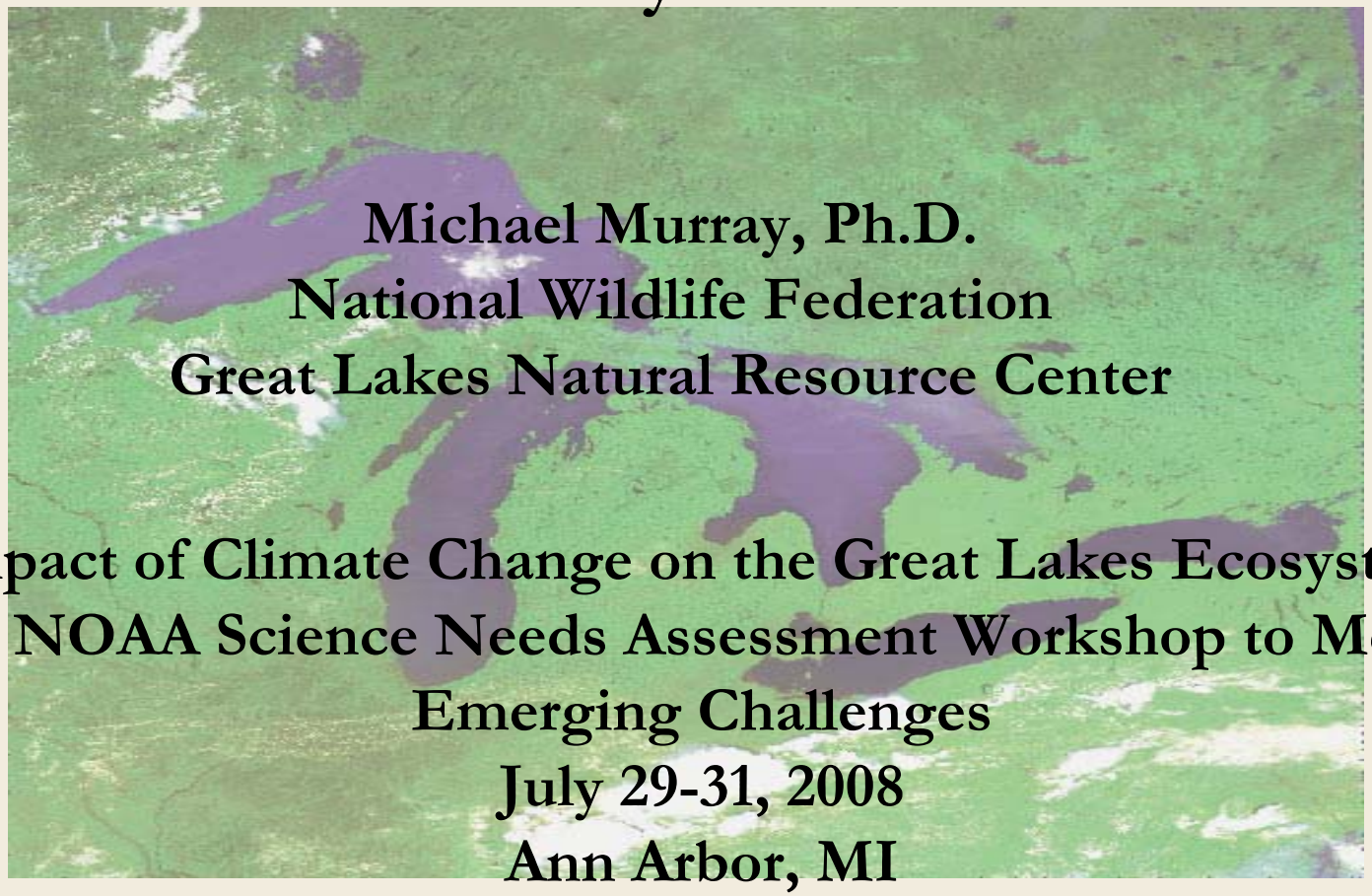
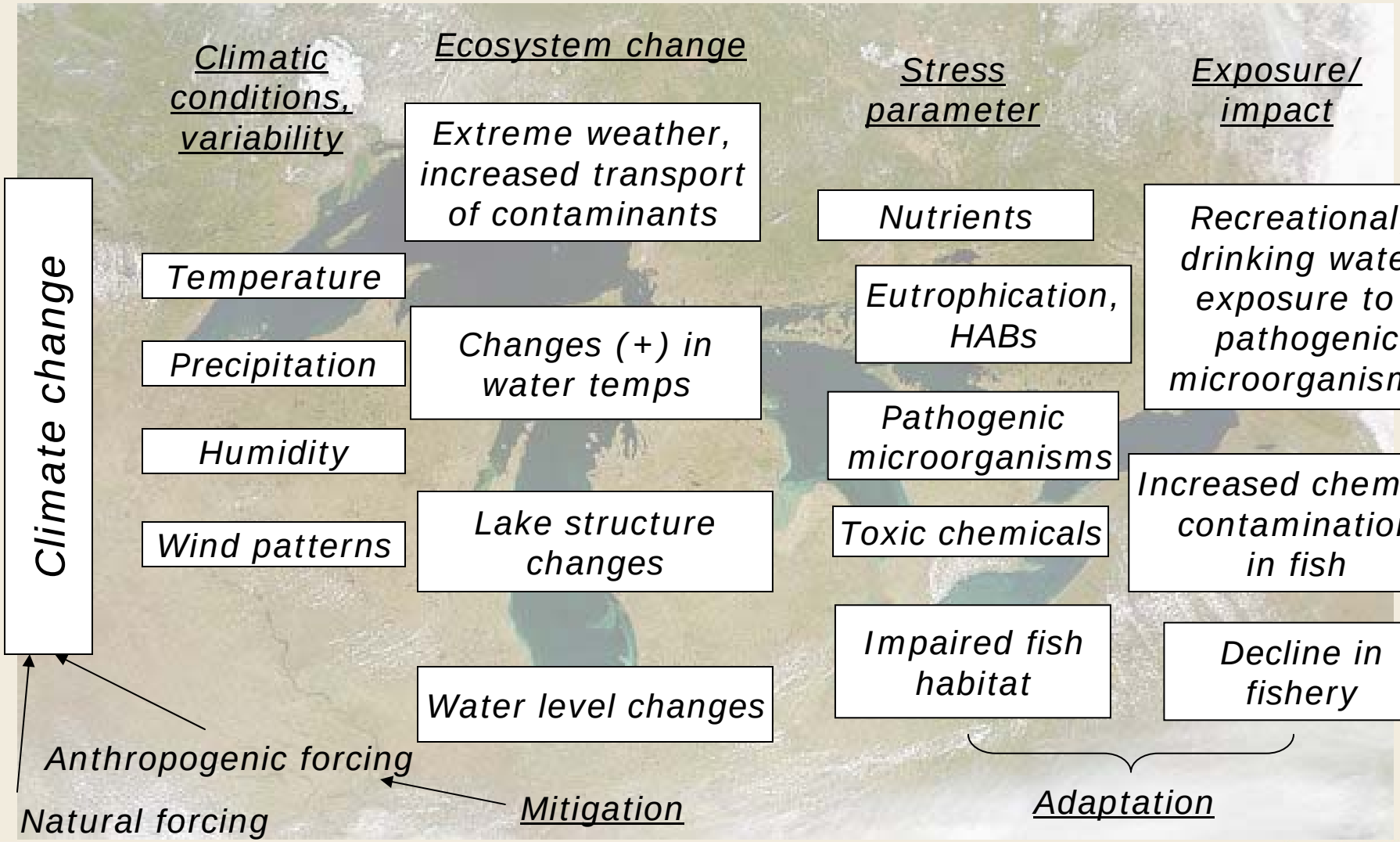
Climate Change, Water Quality, and Human Health in the Great Lakes: Some Research and Policy Needs



Michael Murray, Ph.D.
National Wildlife Federation
Great Lakes Natural Resource Center

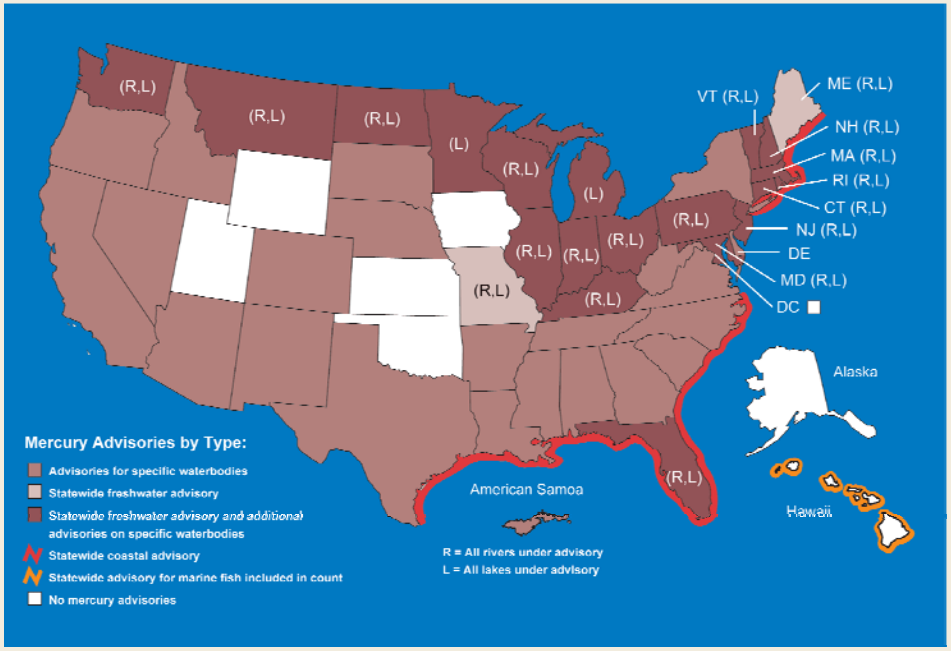
Impact of Climate Change on the Great Lakes Ecosystem: A NOAA Science Needs Assessment Workshop to Meet Emerging Challenges
July 29-31, 2008
Ann Arbor, MI

Schematic of Potential Climate Change Impacts on Health via Changes in (Fresh)water Quality



Based in part on McMichael et al., 2006, *Lancet*, 367:859:869.

Mercury Fish Consumption Advisories and Potential Increased Mercury Exposure with Climate Change



Source: U.S. EPA, *National Listing of Fish Advisories, data for 2004*

- Extreme weather events can increase mobilization of contaminated soils, sediments
- Climate can influence volatilization and hydro. flux
- All else equal, bioavailable inorganic Hg and Hg methylation increases with increasing temperature
- May be of greater significance in inland lakes

Source: e.g. Hurley et al., 1995; Jackson, T.A. 1998; Grigal, 2003.

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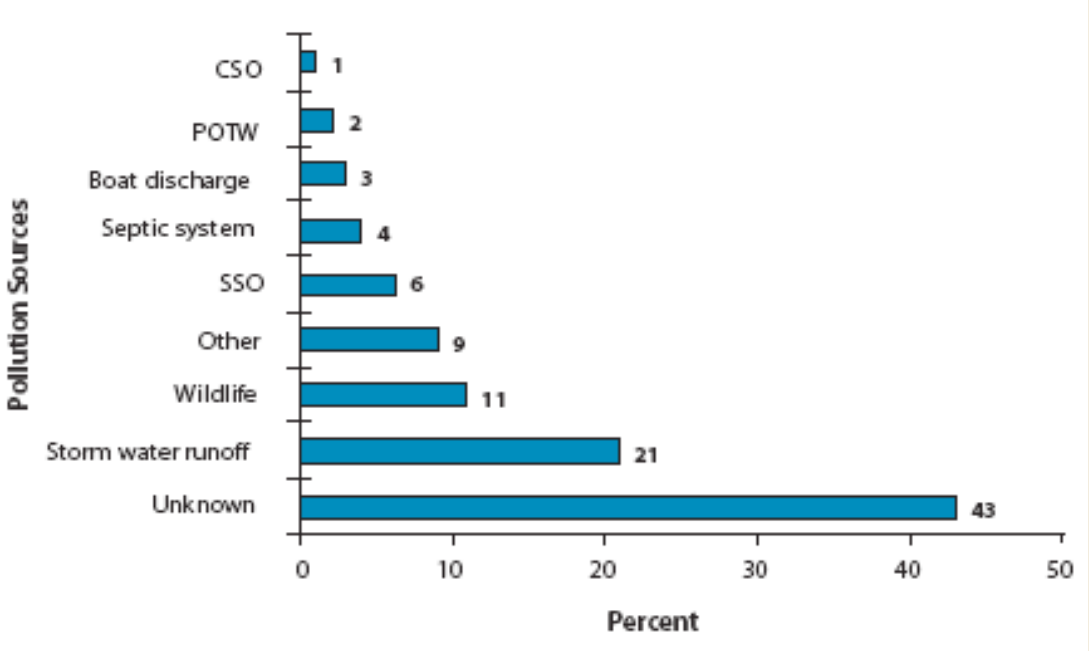
Sources of Pollution Leading to Swimming Beach Advisories and Closings in U.S. (2002)

- Principle pollutants of concern in combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) are microbial pathogens, oxygen depleting substances, TSS, toxic chemicals, nutrients, flotables/trash



- Ongoing need to better understand sources of microbial pollution

Source: EPA, 2004, Report to Congress on Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows, Figure ES-3.

CSO Correction Needs by State

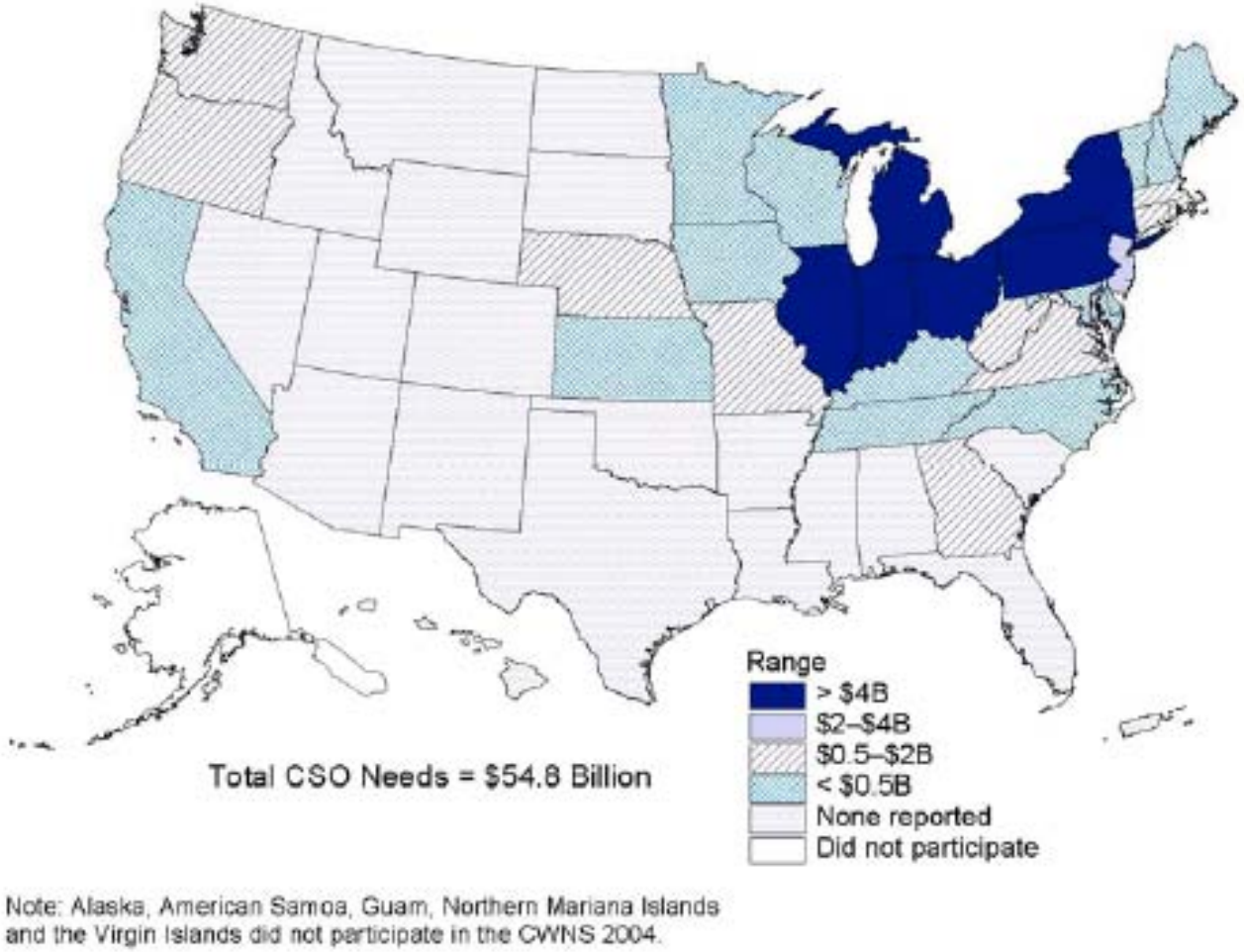


Figure 2-5. Distribution of CSO correction (Category V) needs by State (January 2004 dollars in billions).

Source: EPA, 2008, *Clean Watersheds Needs Survey, 2004 Report to Congress*, Jan. 2008.

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Clean Watersheds Needs Survey, Needs for U.S.

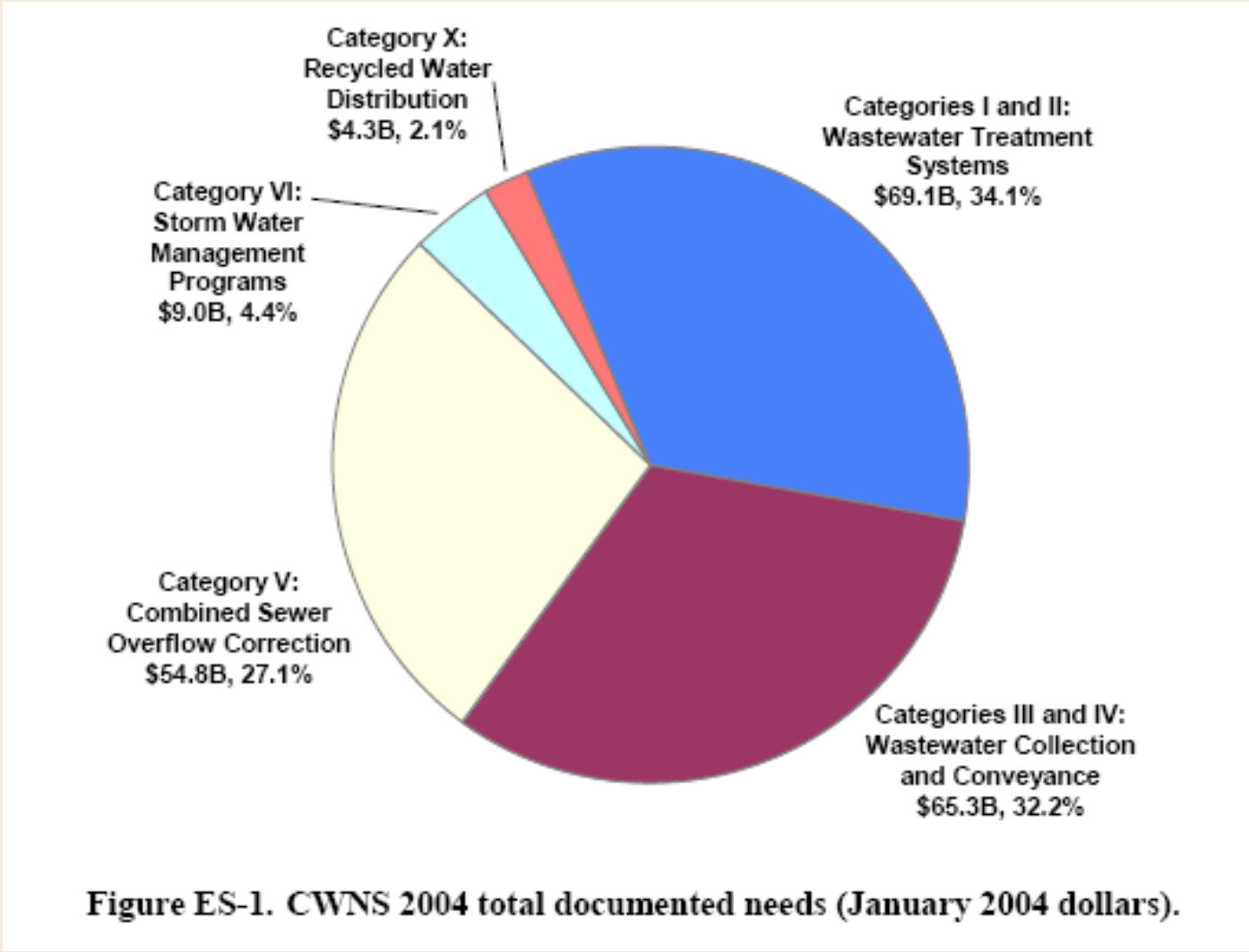

Figure ES-1. CWNS 2004 total documented needs (January 2004 dollars).

Source: EPA, 2008, *Clean Watersheds Needs Survey, 2004 Report to Congress*, Jan. 2008.

References to "Climate Change" or "Global Warming" in Selected Recent Water Quality-Related Documents

Report	Number of Mentions
Great Lakes Regional Collaboration Strategy (2005)	0
U.S. EPA, The Clean Water and Drinking Water Infrastructure Gap Analysis (2002)	3*
U.S. EPA, Report to Congress: Impacts and Controls of CSOs and SSOs (2004)	2**
U.S. EPA, Peak Wet Weather Policy, Proposed (2005)***	0
U.S. EPA, Report to Congress, Combined Sewer Overflows to the Lake Michigan Basin (2007)	0
U.S. EPA, Clean Watersheds Needs Survey, 2004 Report to Congress (2008)	0

*: References climate generally as one factor affecting pipe life.

**:References climate generally as one factor involved in choice of control technology and in O&M costs.

***: Memorandum from Benjamin Grumbles, Assistant Administrator, Office of Water, to EPA Regional Administrators, undated (2005)

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But Recent Progress in Considering Climate/Water Science/Policy Issues, Including in Great Lakes

- U.S. Climate Change Science Program, *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States* (SAP 4.3) (2008)
- U.S. EPA, *A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflow Mitigation in the Great Lakes and New England Regions* (2008)
- U.S. EPA, *National Water Program Strategy: Response to Climate Change*, Public Review Draft (March 2008)
- Dempsey et al., (Healing Our Waters® - Great Lakes Coalition), *Great Lakes Restoration and the Threat of Global Warming* (2008)
- Science/policy meetings, including at University of Michigan, and climate/Great Lakes meetings at Michigan State University (ESPP), 2006-08.

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EPA Water Program Areas Potentially Affected by Climate Change

Drinking Water Standards	Surface Water Standards	Technology Based Standards	Emergency Planning
Drinking Water Planning	Clean Water Planning	Water Monitoring	Water Restoration/TMDLs
Underground Injection Control Permits	Discharge Permits	Storm Water Permits	Wetlands Permits
Source Water Protection	Nonpoint Pollution Control	Coastal Zone	National Estuaries Program
Drinking Water SRF	Clean Water SRF	Ocean Protection	Combined Sewer Overflow Plans

Note: Shaded areas identify programs potentially affected by air and water temperature increases.

Source: EPA, *National Water Program Strategy: Response to Climate Change*, Public Review Draft, March 2008.

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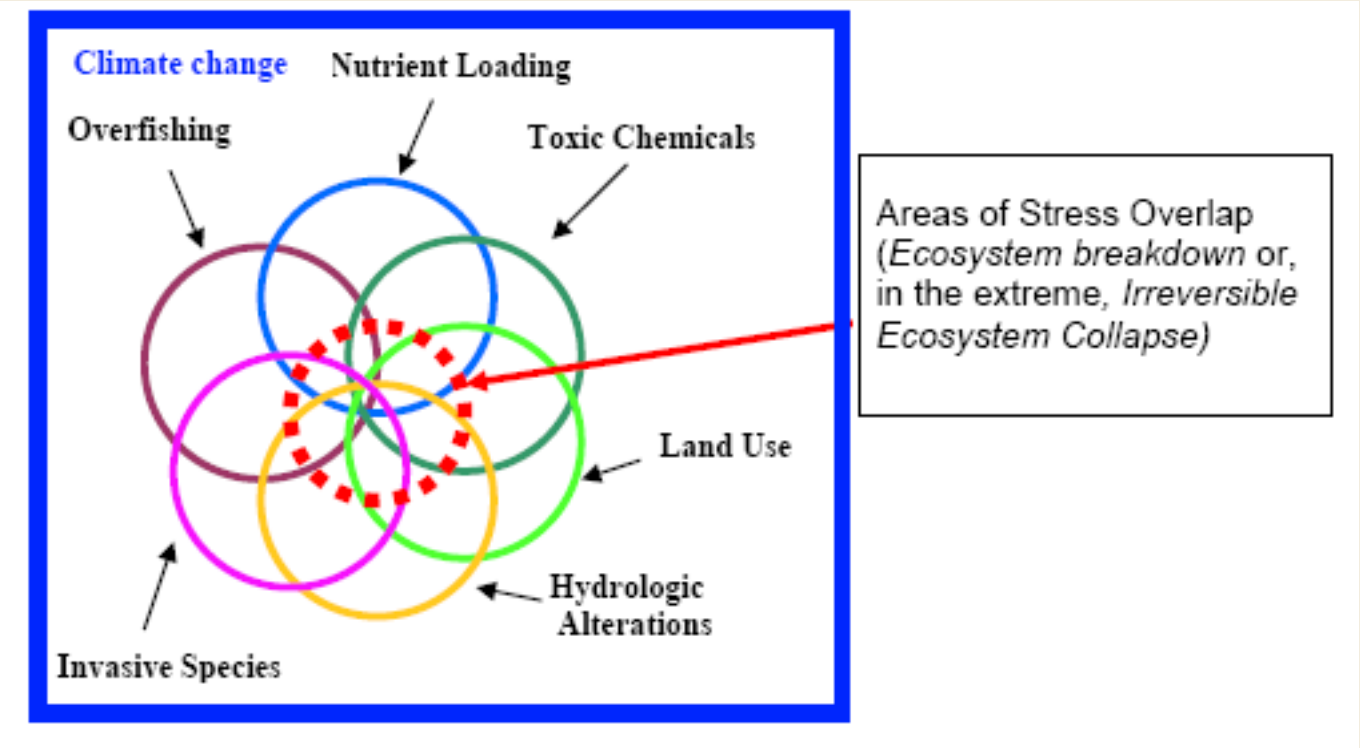
Considering Multiple Stresses:
Prescription for Great Lakes Ecosystem Protection and Restoration

- Report prepared by Healing Our Waters Technical Advisory Committee members on multiple stresses to Great Lakes



- Restore
- Remediate
- Protect
- Measure

Source: Bails et al., 2005; available at http://www.healthylakes.org

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Climate, Water Quality, and Human Health in Great Lakes – Some Research Needs

- Potential increased mobilization of toxic chemicals (both historic and current use/release), as well as pathogenic organisms, in warming climate; improved microbial source tracking and more rapid detection and notification systems
- Climate impacts on mobilization of nutrients, increased eutrophication, hazardous algal blooms
- Climate impacts on lake characteristics (T, lake structure), implications for different fish species (and for people heavily reliant on fish consumption in diet)
- Effect of interaction of numerous factors (e.g., climate, land use changes, baseline pollutant loadings, aquatic invasive species, food web changes) on proximate stresses to human health

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Climate, Water Quality, and Human Health in Great Lakes – Policy/Regulatory Science Needs

- Increased consideration of climate change in numerous water programs, including at federal, state, and municipal levels
- In particular, need greater attention to climate in programs for nonpoint sources (including urban and agricultural runoff)
- In considering broader Great Lakes restoration, need to account for potential climate change in planning many diverse efforts (including coastal habitat restoration, aquatic invasive species control and prevention, fisheries management)
- Need to ensure coordination with Canada on Great Lakes programs

Source: TNC

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